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14. ABSTRACT

The work performed under the "ARGOS/EUVIP Data Development and Utilization" grant is detailed in this annual report. Theoretical work on the coupling between the plasmasphere and the ionosphere was continued. Computational analysis of the coupling between the plasmasphere and the global state of the magnetosphere (as given by a global MHD model) was initiated. Analysis of the data from the EUVIP instrument continued.

15. SUBJECT TERMS

plasmasphere, remote sensing, ARGOS satellite, EUVIP instrument

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ARGOS/EUVIP Data Development and Utilization

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LONG-TERM GOALS

My long term goal is to understand the density structure of the Earth's plasmasphere, and the physical processes that contribute to the formation of the plasmapause. Of particular interest is the coupling between the plsmasphere and the ionosphere, and the use of global helium images to obtain the density structure and to constrain any theoretical model.

OBJECTIVES

I wish to refine my current model of the plasmasphere, the Multi-Species Kinetic Model of the Plasmasphere (MSKPM), using a numerical model (FLIP) for the topside ionosphere and an MHD model for the large-scale convection electric field. I also wish to validate MSKPM using the data from the Extreme Ultraviolet Imaging Photometer (EUVIP) instrument on the Advanced Research and Global Observation Satellite (ARGOS). EUVIP will measure the 30.4 nm sunlight scattered by helium ions in the topside ionosphere and the plasmasphere. Inversion of this data (Meier, 1998) is necessary to recover the density structure and any parameters that govern the density structure.

APPROACH

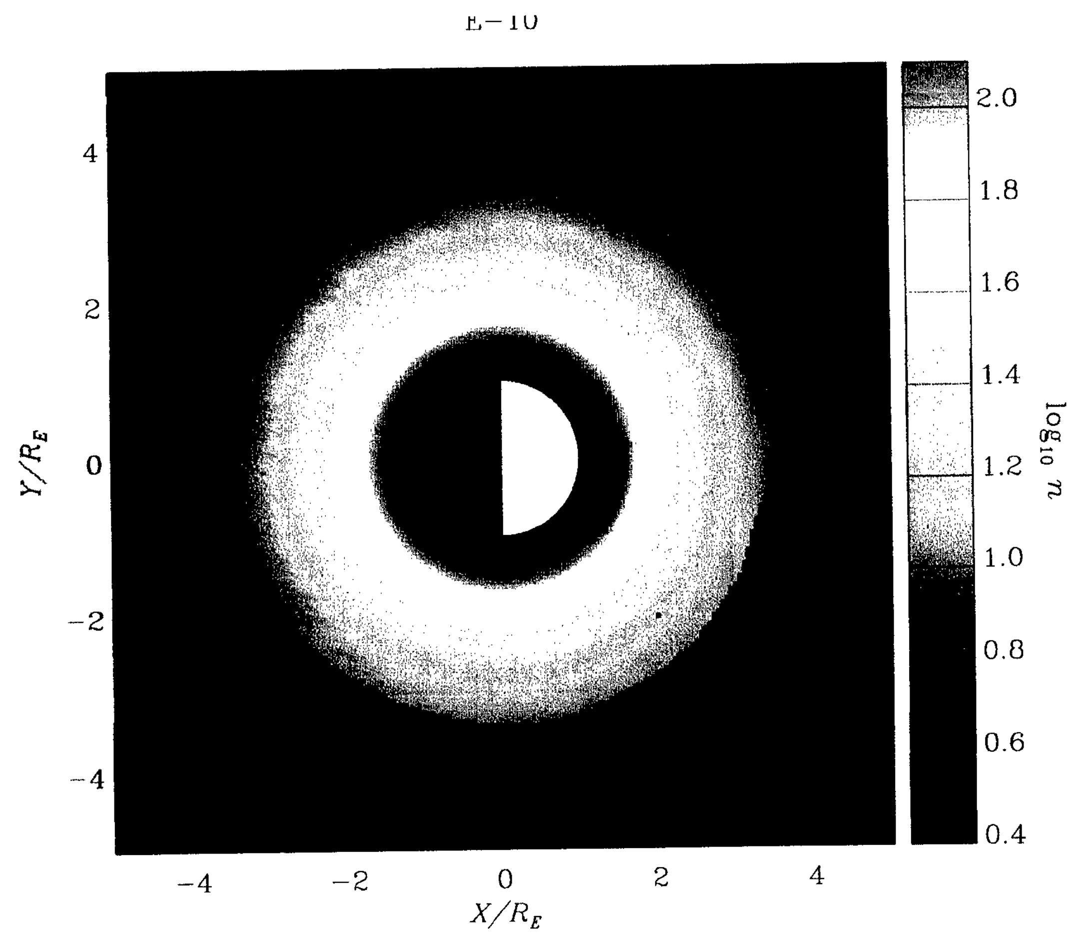
I will incorporate into MSKPM both realistic boundary conditions by using the exobase model being investigated at NRL as well as the global MHD model that was developed at NRL. In addition, I will obtain the instrument data from the Naval Research Laboratory (NRL), which is analyzing the data from other instruments on the same satellite, and, with the assistance of Eric Korpela, the EUVIP project scientist at UC Berkeley, process the data for scientific analysis. My graduate student will be responsible for processing the EUVIP data, comparing it to the model MSKPM, and improving the model. Guru Ganguli and Steve Slinker at NRL, and Daniel Melendez at NOAA (formerly of NRL) will collaborate on the theoretical issues.

WORK COMPLETED

I have added a realistic lower boundary condition to MSKPM, and this work was presented at the AGU Fall Meeting in December 1999 and is currently in press (Reynolds et al., 2000). In addition, I have worked with Daniel Melendez to understand in detail the structure of the topside ionosphere and how is acts as a source for the plasmasphere. This work is about to be submitted for publication (Melendez et al., 2000). I have developed a general electric field module for MKSPM, and incorporated the output of the Fedder-Lyon MHD code. Preliminary results of this work were presented at the AGU Spring Meeting in June 2000 (see the Reference section). In addition, I have obtained some of the data processing algorithms from Eric Korpela, and have applied them to preliminary EUVIP data. I am currently working on obtaining the EUVIP data in a regular fashion.

RESULTS

I have shown that a local-time dependent exobase can be quite important in determining the density structure of the plasmasphere. An altitude and density variation on the order of 100% can be strong enough to swamp the effects of diurnal convection. Details are shown in Reynolds et al. (2000). I have also demonstrated that it is possible to incorporate realistic convection electric field structures into MSKPM. Indeed, I have incorporated the electric field output from an MHD magnetospheric code at NRL. An example is shown in the figure below. This figure depicts the helium ion density in the magnetic equatorial plane for the case of a solar wind with an eastward IMF and a density of 10 cm^{-3}. This is approximately proportional to the intensity of the 30.4 nm solar-scattered radiation that a satellite would detect from above the north pole. It is important to note that the structure near the plasmapause can be clearly seen. This work was presented at the AGU Spring Meeting in June 2000. I have achieved no results with regard to the EUVIP instrument as the data is still in the process of being downloaded and analyzed.



1. Helium density in the equatorial plane when the solar wind has a density of 10 cm^{-3} and an eastward IMF. See the Publications section for the reference information.

IMPACT/APPLICATIONS

An accurate model of the density, composition, and temperature structure of the plasmasphere is necessary to interpret the results of NASA's IMAGE.satellite, which was launched in early 2000, and which will also measure the helium density, but from a global perspective. In addition, this kind of first-principles model will greatly enhance the understanding of space weather as it applies to the plasmasphere.

TRANSITIONS

This model will ultimately be parameterized into an operational model that space weather forecasters will be able to use to predict the impact on Earth of conditions in space.

RELATED PROJECTS

A study of the quiet time structure of the plasmaspheric density, as measured by the Los Alamos National laboratory geosynchronous satellites, is currently underway. This calibration will improve the accuracy of MSKPM and provide the initial conditions for time-dependent (i.e., storm) studies. In addition, a study of the structure of the large-scale convection electric field is also underway. This electric field governs the particle dynamics of such populations as the rung current and the radiation belts as well as the plasmaspheric population.

REFERENCES

Meier, R. R., A. C. Nicholas, J. M. Picone, D. J. Melendez-Alvira, G. Ganguli, M. A. Reynolds, and E. C. Roelof, "Inversion of plasmaspheric EUV remote sensing data from the STP 72-1 satellite," *J. Geophys. Res.* **103**, 17505-17518 (1998).

AGU Fall Meeting, December 1999

M. A. Reynolds, G. Ganguli, and D. J. Melendez-Alvira, "The effects on global plasmaspheric structure due to a local-time dependent exobase," SM41A-29.

AGU Spring Meeting, June 2000

M. A. Reynolds, S. Slinker, and G. Ganguli, "The dependence of the convection electric field and the plasmaspheric morphology on the solar wind parameters," SM51B-19.

K. Barry, M. A. Reynolds, E. Korpela, and S. Bowyer, "Initial EUV Results from ARGOS/EUVIP," SM51B-18.

PUBLICATIONS

M. A. Reynolds, D. J. Melendez-Avira, and G. Ganguli, "Equatorial coupling between the plasmasphere and the topside ionosphere," in press, *Journal of Atmospheric and Solar-Terrestrial Physics*.

G. Ganguli, M. A. Reynolds, and M. W. Liemohn, "Recent advances in plasmaspheric research," in press, *Journal of Atmospheric and Solar-Terrestrial Research*. (this paper was invited)

D. J. Melendez-Avira, M. A. Reynolds, and G. Ganguli, "The terrestrial ion exobase," in preparation, to be submitted to the *Journal of Geophysical Research*.